JAMIOLAS 2.0: Supporting to Learn Japanese Mimetic Words and Onomatopoeia with Wireless Sensor Networks

Masayuki Miyata, Hiroaki Ogata, Tomoo Kondo, and Yoneo Yano
Dept. of Information Science and Intelligent Systems, University of Tokushima, Japan
miyata@is.tokushima-u.ac.jp

Abstract: This paper proposes an improved context-aware language supported system for learning Japanese mimetic words and onomatopoeia (MIO) using wireless sensor network "MOTE". In our previous work, a learner wears sensors so that the system provides the appropriate MIO expressions at his/her place. In this current system called JAMIOLAS (Supporting Japanese Mimetic words and Onomatopoeia Learning with Sensors for Non-Japanese) 2.0, MOTE is used to get appropriate data from the environment, for example, temperature and light. The system recommends the right place for the right person to learn right MIO expressions. This paper describes the implementation, the interface and usage scenario of JAMIOLAS 2.0.

Keywords: mimetic word, onomatopoeia, wireless sensor network, ubiquitous learning, mobile learning

Introduction

Context-aware computing [1] will help the organization and mediation of social interactions wherever and whenever these contexts might occur. Its evolution has recently been accelerated by improved wireless telecommunications capabilities, open networks, continuous increase in computing power, improved battery technology, and the emergence of flexible software architectures. With those technologies, an individual learning environment can be embedded in daily life.

Computer Supported Ubiquitous Learning (CSUL) has integrated high mobility with embedded computing environments [2][3]. While the learner is moving with his/her mobile device, the system dynamically supports his/her learning by communicating with embedded computers and sensors in the environment. RFID (Radio Frequency Identification) tags are often used to realize pervasive embedded computing. It is expected that the sensor becomes one of the key technology to solve a social problem in the 21st century.

The main characteristics of ubiquitous learning are shown as follows [4][5]:

(1) Permanency: Learners never lose their work unless it is purposefully deleted. In addition, all the learning processes are recorded continuously everyday.
(2) Accessibility: Learners have access to their documents, data, or videos from anywhere. That information is provided based on their requests. Therefore, the learning involved in this system is self-directed.
(3) Immediacy: Wherever learners are, they can get any information immediately. Thus, learners can solve problems quickly. Otherwise, the learner can record the questions and look for the answer later.

(4) Interactivity: Learners can interact with experts, teachers, or peers in the form of synchronous or asynchronous communication. Hence, the experts are more reachable and the knowledge becomes more available.
(5) Situating of instructional activities: The learning could be embedded in our daily life. The problems encountered as well as the knowledge required are all presented in their natural and authentic forms. This helps learners by notifying the features of the problems and provides relevant actions.

We focus on applying CSUL to language learning and are investigating computer supported ubiquitous learning [3]. We proposed context-aware language-learning support system for learning Japanese mimetic words and onomatopoeia expressions, which is called JAMIOLAS [6][7]. The learner wears sensors and s/he can learn MIO with this system. However this system has several issues, for example, the learner can learn MIO only at the spot. It is considered that we should install a sensor in the various places in order to solve these issues. Therefore this paper proposes a system improved JAMIOLAS with wireless sensor network, which is called JAMIOLAS (Supporting Japanese Mimetic words and Onomatopoeia Learning with Sensors for Non-Japanese) 2.0.

1. Mimetic words and onomatopoeia expression

Japanese language is very rich in mimetic words and onomatopoeia (MIO). Mimetic words are imitating situations and body movements. For example, “uro uro suru” means walking around aimlessly. On the other hand, onomatopoeia shows sounds of something, such as animals and natural phenomena. For example, “gaya gaya suru” means a very noisy situation. Japanese language has about 2,000 MIO. If students can use these expressions correctly, their conversation will be more rich, natural, emotional and lively. For example, MIO are often used in word balloons in Japanese cartoons, “Manga”. In addition, those words are much related to Japanese culture itself. Therefore learning MIO is very useful not only to have rich communication with Japanese native speakers, but also to understand Japanese culture.

Generally, 4 skills (reading, writing, listening, and speaking) are main objectives in language learning. Only a few MIO could be taught in Japanese language learning courses for international students because time limitation. Therefore, students have to acquire more words in their daily life. However, it is very difficult to learn those words because the expressions vary according to the situation. If the expressions are not used properly, they might sound comical and strange. Moreover, it might lead to misunderstanding in conversation. Therefore, it is very important for non-Japanese to better understand the situation.

Japanese MIO expressions mainly have following features:
(1) It is very difficult to express the meaning of MIO, because their expressions are based on some senses such as hearing, vision, touch, taste, smell, and spirit. For example, onomatopoeias for raining vary depending on the sound of rain, such as “potsu potsu”, “shito shito”, “zah zah”, “jah jah” and “bisya bisya”.
(2) MIO have many synonyms and much assonance. For example, “pyuh pyuh”, “hyuh hyuh” and “byuh byuh” mean sounds of wind, but they are used in slightly different situation. Therefore, international students have difficulty in using them adequately.
(3) Furthermore “bochi bochi”, most of the MIO consist of twice repetition of one word and are written in Hiragana or Katakana, not in Kanji (Chinese characters). Therefore, it is easy to understand them in a written form, but very difficult to understand and use them correctly in conversations.

The usage of MIO depends on the situation. Therefore, we proposed a system to learn MIO using sensors, which detect the speaker's situation, are described in the following section.

2. JAMIOLAS and its issues

We developed JAMIOLAS system in our previous research. This system supports learning MIO using a sensor called Phidgets. The learner wears Phidgets connected to the system, and the system can receive information as digital data from environment around learner. The system presents the question about MIO, suitable for the situation by the received data, and the learner can learn MIO. However JAMIOLAS has following limitations:

(1) The learner might not be able to know what kind of MIO can learn from other places by the system. Therefore the learner may miss out learning chance.
(2) There is a possibility that the learner becomes worried because s/he needs to carry the system.
(3) There is a possibility that the learner must go around in a blind way in order to look for places to be able to learn MIO.

We should install a sensor in the various places in order to solve these issues. Therefore this paper proposes JAMIOLAS 2.0 supported learning MIO with wireless sensor network "MOTE".

3. JAMIOLAS 2.0

3.1 Wireless sensor network "MOTE"

Wireless sensor network is defined as "*network of autonomously dispersion type which can collect information without wire using sensor nodes in real time*". In this paper, we use "MOTE" [8], as a wireless sensor network. The gateway of MOTE acquires data automatically just to put sensor nodes at every spot. The sensor node will response to temperature, illuminance, sound, and so on.

3.2 Implementation

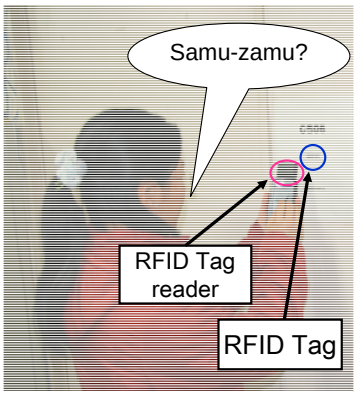


Figure 1. Usage scene

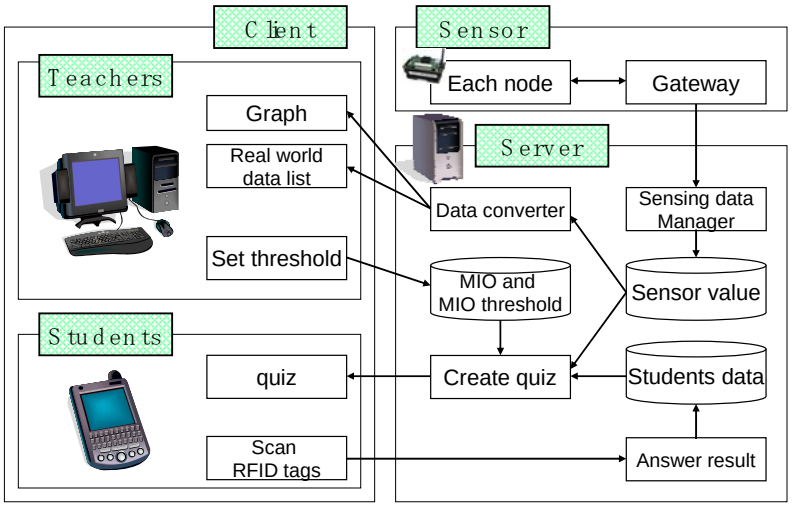


Figure 2. System architecture

We have developed the prototype system of JAMIOLAS 2.0 on Pocket PC with Windows Mobile 5.0, Server with LAMP (Vine Linux 4.1 + Apache2 + PHP5 + MySQL5), RFID tags reader/writer, and MOTE. The program has been implementing using Visual C# 2005.

As shown in Figure 2, JAMIOLAS 2.0 consists of a main client-server and sensor components. The client consists of the computers used by Japanese-language teacher's part and the PDA's used by the students outside the classroom. On the other hand, the server can be divided into two main parts, namely the interface and the data processing component. The database stores sensor value, MIO, MIO thresholds and students' data.

3.3 System interface and function

3.3.1 Student's interface

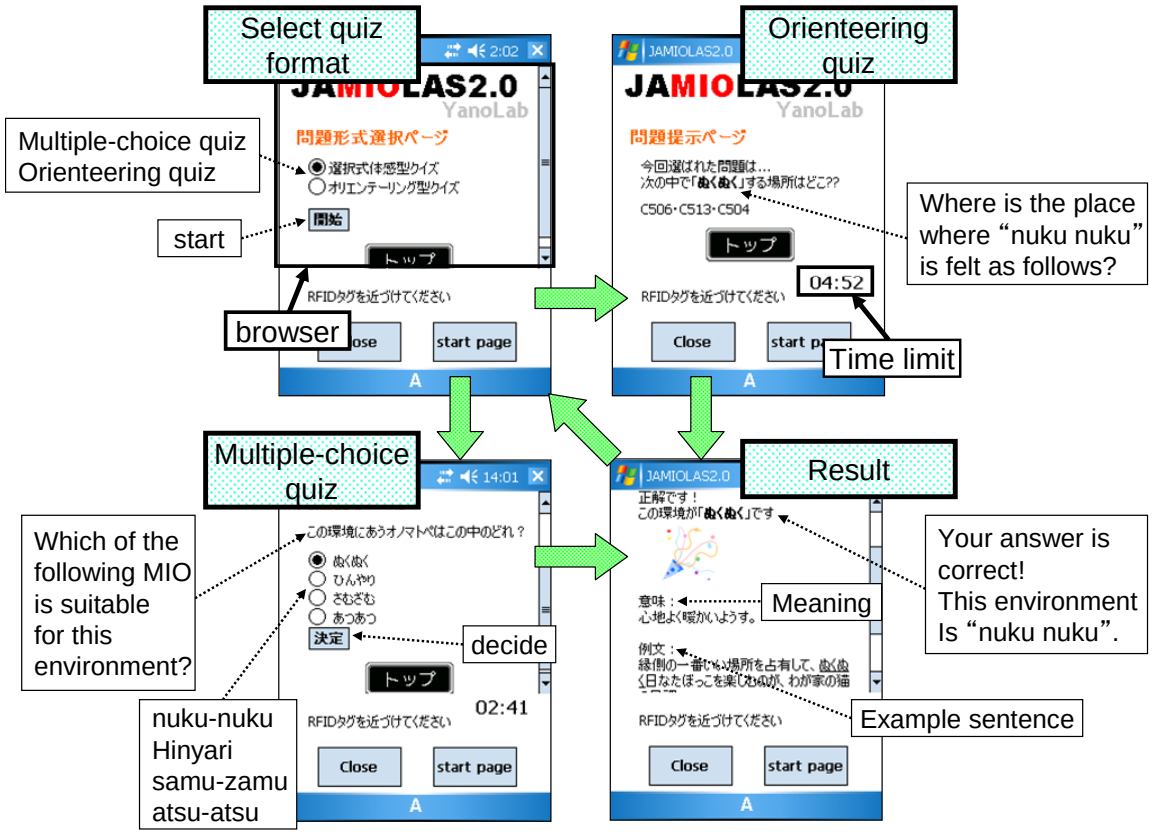


Figure 3. User interface for student

As shown in Figure 3, JAMIOLAS 2.0 for students has following interface:

(1) Select quiz format: The student can select either multiple-choice quiz or orienteering quiz from quiz format. When the student selects multiple-choice quiz, the screen page of PDA displays the page, the student has gone freely the spot placed RFID tag and node of MOTE. When the student selects orienteering quiz, the screen page of PDA display page of orienteering quiz.

(2) Multiple-choice quiz: When the student goes to the spot placed a node of MOTE and a RFID tag and scan it with RFID tags reader attached PDA, screen page of PDA display this page. The student selects and solves MIO suitable for the spot where s/he is now from multiple MIO presented by this system.

(3) Orienteering quiz: When the student select orienteering quiz, screen page of PDA display this page. The system presents one MIO and multiple spots placed a node of

MOTE and a RFID tag. The student looks for and goes to the spot where s/he can feel MIO suitable the situation from the multiple spots.

(4) Result: The screen page of PDA displays the result. When the student chooses the correct answer, the system presents meaning and example sentence of the MIO. As a result, the student can reach in depth of his/her understanding about the MIO. When the student chooses the wrong answer from multiple-choice quiz, the system recommends the spot, where s/he can learn the MIO that s/he selected.

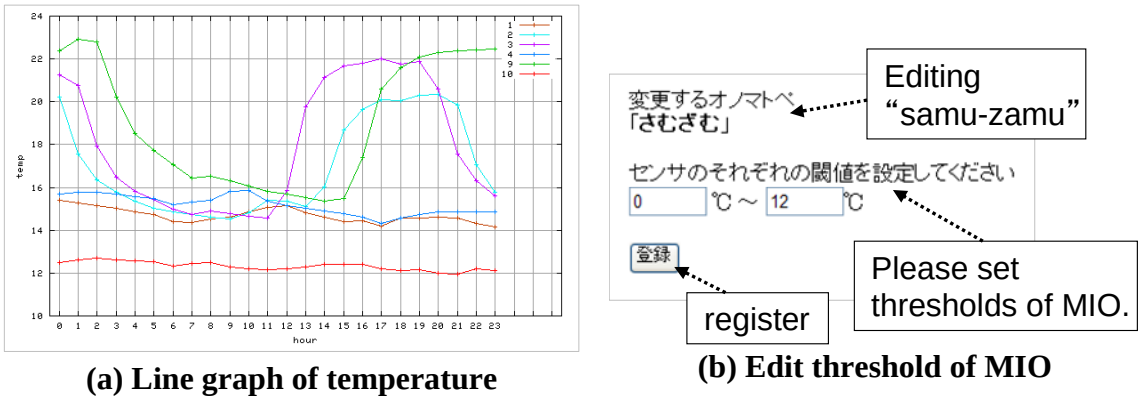
Each quiz has set time limit and the screen page will display remaining time. In addition, MIO selected by this system appeared randomly. The system changes appearance ratio of the MIO with the level of understanding of the student.

3.3.2 Teacher's interface

As shown in Figure 4, JAMIOLAS 2.0 for teacher has following functions:

(1) Function to support setting threshold of MIO: This system needs to set the threshold of MIO by Japanese feeling. However it is difficult to set the threshold, without referring to anything. The system can set the threshold by varied functions, For example, line graph as shown in Figure 4(a), list of real world data. The line graph can visualize real world data stored in the database on an hourly, a daily or monthly. Figure 4(a) is line graph about temperature on a day at each place put sensor node. The list of real world data can look at quantified real world data in the database, and has search function.

(2) Set threshold of MIO: The teacher can look over all registered MIO and their kind and threshold. S/he can select MIO from list and set their threshold, for example, threshold of "Samu-zamu" is from 0 to 12 degrees centigrade as shown in Figure 4(b). In this case, it is highly possible that each teacher set piecemeal threshold. To solve this problem, the system selects MIO of majority in coincident MIO between thresholds.



(a) Line graph of temperature **(b) Edit threshold of MIO**

Figure 4. User interface for teacher

4. Evaluation

4.1 Method

An experiment was done in order to evaluate the JAMIOLAS 2.0 usages. 2 groups were involved with the experiment. 16 Japanese undergraduates and postgraduates take part as Japanese-language teachers and 4 international students who have studied Japanese language take part as learners.

Firstly, as shown in Figure 5, we prepared 6 rooms and the corridor where conditions

varied, for example, we made a room hot with air conditioner (C506) and turned off a light in a room (C504 and C508). 10 words shown in Table 1 were registered in the database. Afterwards, Each Japanese student registered thresholds of these MIO with web browser of notebook PC, tablet PC, PDA and so on. Since, international students went out pretest. They studied MIO with dictionary for 10 minutes. They went out mid test. Afterwards, they felt free to learn using this system with PDA for 10 minutes. Lastly, they went out posttest.

Each test has 2 category, feeling type and example sentence type. The feeling type was with multiple choice questions from which they can select MIO suitable for each situation. The example sentence type was with fill-in-the-blank type questions that they select suitable MIO to complete a sentence. There were 5 questions in each category and 10 questions in total. After this experiment, Japanese and international students who used this system answered different questionnaires respectively. The questionnaire of 5 ranges from 1 to 5, of which 5 is the highest value.

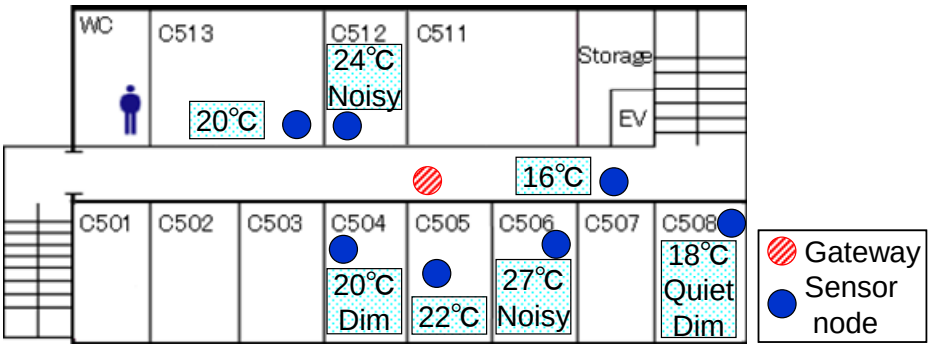


Figure 5. Environment of Evaluation experiment

Table 1. Mimetic words and onomatopoeia used in the experimentation

Subject	Sensor	MIO words
Temperature	Temperature	samu-zamu, hinyari, nuku-nuku, atsu-atsu, poka-poka
Light	Illuminance	chira-chira, pika-pika, gira-gira
Sound	Sound	shiin, gaya-gaya

4.2 Result

4.2.1 Evaluation by Japanese students

Table 2. Result of the questionnaire by Japanese students

No.	Question item	Average	SD
Q1	Were there mimetic words and onomatopoeia close to your sense?	3.5	1.16
Q2	Were you able to set the threshold easily?	3.1	0.92

Table 2 shows result of the questionnaire by Japanese students group. From the result of Q1, we can conclude that some students could not find the suitable MIO that is close to their sense. This is because we have registered MIO beforehand for the convenience of the experiment and we have made them not be able to register MIO. The result of Q2 shows that it was a bit difficult for Japanese students to set thresholds of MIO. This is due to not being able to set them while looking at functions to support setting them. In addition, this is partly because Japanese students cannot set thresholds of MIO while comparing other. This is because this system can set thresholds by only one MIO.

Functions to support setting thresholds of this system are received a quite acclaim, for example, the function of line graph is seen easily and easy to understand. Therefore this system will be able to reduce a burden for the Japanese student by solving these issues.

4.2.2 Evaluation by international students

Table 3 shows result of the questionnaire by international students group. Results of Q3, Q5, Q6 and Q7 show that learning MIO with this system holds promise of learning effect than conventional learning and the learner can learn amusing and effectively. However MIO which are answer of quiz were often different in the similar situation from Q4. This is attributed to the fact that illuminance and sound sensor have likely a margin of error.

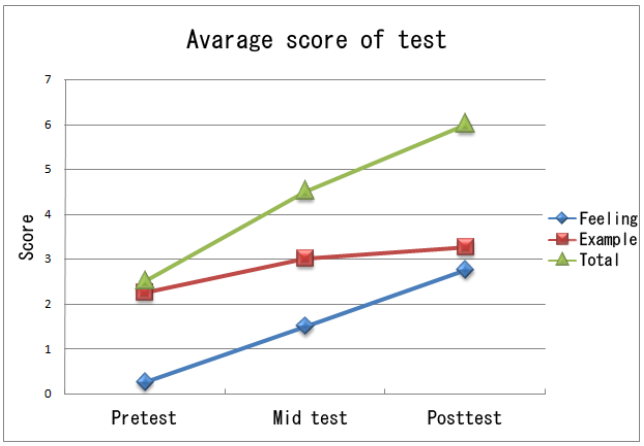


Figure 6. Result of test by international students

As shown in Figure 6, question of the sense type raise international students' grades with this system. Therefore it is thought that international students understood what kind of MIO they used in varied situations. However example sentence type is little to choose between after learning with dictionary and after learning with this system. The sentences used in this system are also available in dictionary. In addition, international students did not understand meaning of words using example sentences which each test used and they understand situations of example sentence.

We received feedback from subjects, for example, the learning with this system is interesting and informative and MIO make impression. To give an actual example, a situation which is hot uses "atsu atsu". When a learner learned with this system in the situation, s/he made a mistake at first, but answered it correctly all the time afterwards. However, we received feedback that it is difficult for international students to understand with the interface of this system. This is because the interface is for Japanese. Therefore it was a little bit hard for them to understand MIO and to enjoy with this system. Accordingly, we will improve interface of this system for international students, thereby the system will hold promise of further learning effects.

Table 3. Result of the questionnaire by international students

No.	Question item	Average	SD
Q3	Were you able to learn mimetic words and onomatopoeia by this system?	4.4	0.55
Q4	Was the answer of presented quiz appropriate to the situation?	3.4	1.52
Q5	Were you able to learn mimetic words and onomatopoeia with them enjoying?	4.2	1.3
Q6	Which do you think enhance learning, conventional learning or this system?	3.8	1.3
Q7	Do you want to learn by this system in the future?	4.0	1.22

5. Conclusion and future works

This paper described an improved context-aware language-learning supported system for learning Japanese mimetic words and onomatopoeia expressions with wireless sensor network, named JAMIOLAS 2.0. The system provides the right MIO expressions from the received data via sensor nodes at the learner's place. The initial experimentation showed that the system was effective for learning MIO.

As for the future work, this system needs to improve user friendly interface. For the teacher, the interface of this system will be improved so that the threshold can be set easily, for example, the teacher can set them while referring function to support setting them and comparing other. The interface of this system will be improved for non-Japanese. Furthermore, the number of MIO used in this system will be increased. In addition, the system will be improved in a way that the teacher can register new MIO. Finally, we will conduct an evaluation experiment again.

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